



## DYNAMIC ANALYSIS OVER THE CHANGES IMPACT IN PRODUCTION PROCESS IN AUTOMOTIVE INDUSTRY

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### Abstract

*The development of capacities for being flexible is based on top management, helps firms to manage the environmental uncertainty and tends to increase the companies performances. We propose the hypothesis as both environmental factors and internal resources affect directly the production system and also the company performances. In order to create the present paper we have been done statistical analysis based on impact factors over the internal product and processes. The results show in optimization development phases, the customer involvement brings a major impact in change process and means it can have an impact over the final process and product.*

**Key words:** change request, status, customer, involvement, optimization.

### 1. Introduction

A key aspect of technical change management is to manage efficiently technical changes in product process development. (N. Kattner, 2016).

The human being is the factor with the biggest impact when comes about change management and flow production or process optimization (Murthy, 2007). Identification of entry points for change management is one of the steps we must to follow up to carry out the process.

An important factor in every business company is a good organization and development of the activities. Production process starts from launching the pilot series (the first parts manufactured) and next follow to testing process. Here we include finding and eliminating production process faults.

In automotive industry has multiple factors with direct influence in serial production. All this factors are constantly present in production line and help to a continuous improvement. (TARĂU, 2016, p.7).

Product development has changed massively in last decades. The competition increased and constrain

the companies to deliver diversity in less time. As result, the engineering changes became „unavoidable” because „growing attention of concepts like competitive engineering, simultaneous design, product development platform, mass customization and configuration management”. This means the company’s success depends mostly on a proper management of technical changes in order to „influence the product performances, delays sometimes activities and can have impact over the development costs” (N. Kattner, 2016).

Production flow analysis is a well-established methodology used to transform the traditional functional aspect into product oriented aspect. (Ari-Pekka Hameri, 2011). In order to ensure an optimal production flow, a series of change requests are constantly made which can be launched by an internal associate, customer or even from supplier’s side. The change requests are reflected in the monitoring of all changes brought to a process or product.

A change request contains a series of information which are referring on what follow to be changed in production process. It contains also a question set with the meaning of defining the

necessary steps of change implementation over the product or process. It also assumes the approval of all involved departments in the production process.

A production system needs to reflect the chosen manufacturing strategy of the company and its competitive priorities (Safsten, 2001).

This paper documents the results of research on change requests analysis created and implemented in a certain period of time. This paper is applied to a production system in the automotive industry. The results obtained are highly important to show how external factors influence the production process. The research was done using a primary database applied directly on manufacturing flow/process during March 2018 – January 2021.

This research aims to evaluate how an element influences the process. Thus, this paper brings important information related to finding out the factors which help the production process and also the factors with negative influence over the process with direct implications on management decisions.

## 2. Methodology

It is known that working standards are always adapted. Optimization is an important element in any serial production activity (Lloréns, 2005). The expected results by the company's management depend very much in which way the change requests are implemented and supervised and also by the promptness of these changes. They may bring or not added value on the production process and also on the management process.

Recent research on industrial processes innovation demands a higher focus over optimization activities that often require an adoption process. The implementation of optimization causes the customer to analyse all advantages and disadvantages of the new process or product (Patricia W. Meyers, 2004).

The manufacturing process can be seen as the place where a certain product with certain value enters and during the operations a certain value is added (Platon V., 1990).

The production management has as object the research of efficient and effective organization of production good and services specifying stable operating conditions of the production system fixing objectives and restrictions in which production management will evolve (O. Jaba).

The starting data we collected is from a certain period, March 2018 – January 2021. Each month brought inside the analysis has a certain number of change requests. Change requests can vary through multiple statuses. Always an engineering change request starts with status 10, which represents its preparation, continues through status 22, which represents the planning phase, status 25 represents validation phase, when the request reaches in status 30 it is implemented in the production system. Status 40 represents local confirmation of implementation in the production process and change is implemented. Status 44 is the

confirmation that the change has been implemented globally and status 48 is the completion of change request.

The chosen variables to perform the analysis are the main data of a change request and, if modified, can influence the process it goes through. Each request has a distinguish number. This is one of the variables chosen. Another variable was the month of creating a change request. The next variable was the year of creation each request. With those two variables we determined few requests that we had every month, respectively every year. Another variable was the status of each change request described above. Depending on change next to be implemented it can be chosen a flow type to follow up. Thus, we had in mind also this variable and we found out two types of flow: correction and engineering change. The correction flow is shorter and used when we have changes, such as text modification. The engineering change flow is used for changes which require quality, logistics, production department approval and sometimes also customer approval. Other very important variable that we used are the date when we planned to implement the change request. This date is set when is created the request and can be modified only before the request reaches on status 25, the validation phase. The next variable is the date when take place physical implementation in the production process.

It is a systematic approach in design and development of a product phase, which take in consideration all the elements from life cycle, from concept until withdraw from use. In practice, it is about designing and creating the computer data for process and product and performing tests to certify the quality and optimization results.

The difference between the planning date of implementation of change requests and the date of implementation took place is another variable. The next variable we used was customer involvement. When starts a change request is important to consider the customer involvement.

The customer can be involved only as information but sometimes he has to approve the change. Customer can request also sample with the new modification for performing tests and based on results he offers an approval or rejection change.

Continuous improvement, system supervising and maintenance roles must be performed in the manufacturing company by responsible persons for each production line (Periodic Strain, 1997).

The enterprise organization depends essentially on its importance and manufactured products types. It can be considered the resources of an enterprise are organized according to a structure determined by its functions. The five main functions of the company are: marketing whose role is to find out the market needs, production who reorganize the concept and realization of customer's requests in imposed conditions by company objectives, distribution which ensure the distribution of the finished product, financial which

concerns over enterprise financial resources optimization, human resource which concerns over the personnel management for a smooth running in production area (Deac Ion, 2000).

The research study used descriptive statistics as absolute frequencies, relative frequencies, correlations between the number of days from creation to implementation planning and the number of days from implementation planning to physical implementation (Brandimarte, 1996).

### 3. Research results

Due to the technology and equipment used in the automotive industry and also the company from which the data were analyzed are in a continuous development, adaptation and modernization, there must be an assurance the production system works in optimal parameters.

The company wants to offer, in relation to competitors, products with a higher value at equal costs or with an equal value at lower costs and to build advantageous competitive positions that allow to achieve long-term superior economic performance (Bărbulescu, 1994, course I, pag. 2).

The main factors that are taken into account in the process are:

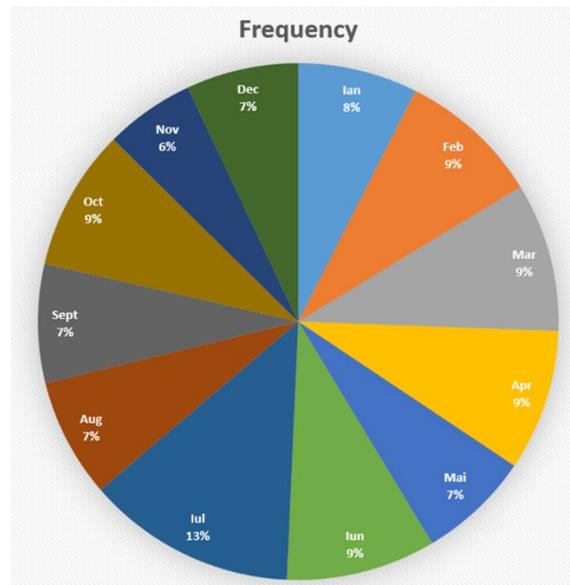
- customer,
- data set for the implementation of a new change,
- process type after change request will follow its course, and, as well,
- the needed documents to certificate that the change request will have a positive impact on the final product.

The entry data of the analyzed change process are collected for the period March 2018 -January 2021, there being a certain number of change requests every month.

Depending on the month a change request was created, the following situations on flow are encountered:

Table 1: Change requests frequency created in each month

Luna creare					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Jan	16	7.4%	7.4%	7.4%
	Feb	19	8.8%	8.8%	16.3%
	Mar	20	9.3%	9.3%	25.6%
	Apr	19	8.8%	8.8%	34.4%
	Mai	15	7.0%	7.0%	41.4%
	Iun	20	9.3%	9.3%	50.7%
	Iul	28	13.0%	13.0%	63.7%
	Aug	16	7.4%	7.4%	71.2%
	Sep	16	7.4%	7.4%	78.6%
	Oct	19	8.8%	8.8%	87.4%
	Nov	12	5.6%	5.6%	93.0%
	Dec	15	7.0%	7.0%	100.0%
Total		215	100.0%		



In table 1 we can see July is the month with the highest recorded frequencies, respectively the month in which most change requests were created. November is the month with the fewest change requests were created.

The result indicates that in the period close to the holidays, the number of requests for change created is increasing. It can be seen that the number of creation of application increases since February, after the associates start to adjust after the holiday period. Another increase is in June, July when the summer holiday comes and the associates want to fulfill their tasks.

The periods with number of creation of change requests decreases is generally the period preceding the holiday. Employees are a little more relaxed as the holidays approach.

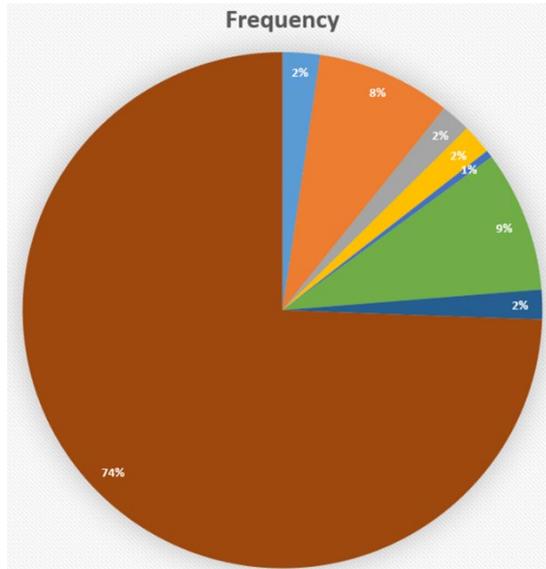
Interpreting the results from the statistical analysis of the data, we find out in March and April are a larger number of change requests created. As a percentage, in March it is an increase of 1.9% compared to January. In May we have a decrease of 2.3% compared to March, and in June and July the percentage increases again by 6%. From August until October the number of change requests decreases again. November and December again have a small number of requests.

These aspects may be due to the fact the months with a low number of applications are during holiday season, either the summer or the end of the year. The months with number of change requests increases are the months which associates are with higher efficiency and productivity and carries out its activity in a much quieter environment, more conducive to concentration to fulfill the tasks.

Depending on a change request's status, the present research paper results the following:

Table 2: Change requests status

Status simbol					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pregatire	5	2.3%	2.3%	2.3%
	Anulat	18	8.4%	8.4%	10.7%
	Faza de planificare	4	1.9%	1.9%	12.6%
	Faza de validare	4	1.9%	1.9%	14.4%
	Start implementare	1	0.5%	0.5%	14.9%
	Confirmare locala implementare	19	8.8%	8.8%	23.7%
	Confirmare globala implementare	4	1.9%	1.9%	25.6%
	Inchis	160	74.4%	74.4%	100.0%
Total		215	100.0%		



Most applications are in status 48, respectively completed. This is quite normal because the statistical analysis is done for a past database, and change requests are normally closed in about three months of starting. This period may vary depending on the type of change, the product which the change is made or the process which the change is made, but also depending on the number of locations where the change is made.

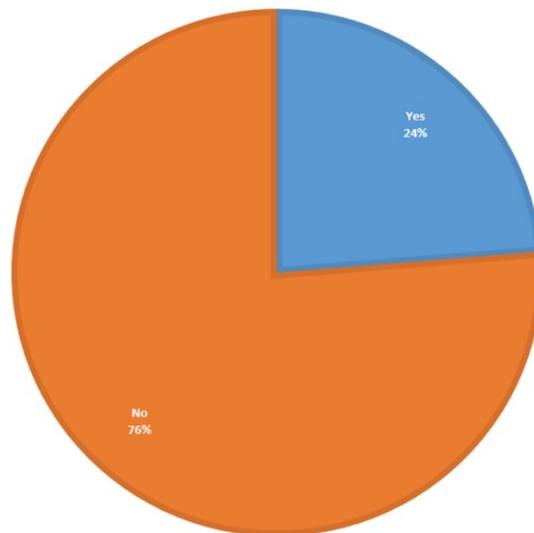
Competition, markets, global supply, globally and regionally distributed production and increased customer expectation for quality and services define the state of business nowadays. The pressure to reduce costs and to be more efficient has forced the business to adapt approaches on production flow management and optimization (Chopra,2001).

Regarding the customer's involvement, the results of the analysis can be found in table 3:

Table 3: Customer involvement frequency

Customer involved					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Da	51	23.7%	23.7%	23.7%
	Nu	164	76.3%	76.3%	100.0%
Total		215	100.0%		

CUSTOMER INVOLVED



The organization will always tend to focus on customer requirements (C.DUMITRESCU).

The research shows that in requests for change, the customer is involved in a percentage of 24%. This shows us that in most cases it does not have to approve a change. Generally in the change request there is a field where it must be specified at the beginning if the client will be informed or his approval is required. If only one information is required, it will be notified before the change request is implemented. The decision of information or approval from the customer is based on an internal matrix. This matrix includes all types of changes that can be made to a product or process. The person who starts the change requests will check using this matrix whether or not the customer's involvement is necessary. The customer should generally be involved when a design, shape or function changes or any change may directly affect him. If it is necessary to be involved as an approver, a customer presentation is required and must be taken into consideration. This presentation is made internally and the responsible persons who are in contact with him will present the new change. If he agrees, the person who created the request will prepare samples with the new change and will send to the customer. The samples are internally made and go through a set of tests that will show if the change is optimal or if there are errors in functionality.

The analysis identifies the results desired by the client. In the optimization process, information about customer requirements and the current production system are required (John Miltenburg, 2008).

#### 4. Proposals and conclusions

The results of the present research conclude that, during a three-year analysis period, most change requests are closed in the system and implemented in the production system, which is quite normal because a change request has an average development period and implementation on a three months. Change requests that still being processed and implemented are

mostly started in the last period of time. When a change request is correction type, the activities in the enterprise are not very long and the period of completion of the development and implementation process is short. It is generally made in the case of changes that do not require approval from all departments involved but they will be only informed.

Inside the organization, meetings are held periodically, once per week or two weeks, where the nominee responsible for change requests according to the product group will present to all responsible persons in the departments involved, the status of open and developing change requests. These regular meetings have the purpose to discuss all the necessary activities needed to be done in order to implement in the production process the change requests.

When the customer is involved in the change request process, the activities involved are more diverse, samples and demonstration documents can be requested to certify that the new change will contain added value to the final product as well as documents prove that the tests of endurance and capability are promoted.

The connection with the customer is maintained by the sales department. The responsible person will provide all the information necessary to make the change as well as the requirements and conditions imposed by the customer. It is important that all points to be reached and the customer expresses his approval in writing.

Once all the confirmations have been obtained, the process of coordinating the change is completed, and the change will be visible in the production line.

The documents related to the production line are completed to confirm the last implemented change, and any non-compliance that is notified will be reported in these documents. The documents used are analyzed daily by the people in charge of the production lines. In case of non-conformities, they must be solved as soon as possible, and if necessary, the production line may be closed until it is solved.

Nowadays technology is gradually becoming the core that increasingly concerns the national industry strategy. Production is advanced manufacturing technology with broad development prospects. Today, technology is evolving in the direction of more varied materials, higher accuracy, higher speed, easier operation, higher reliability and lower costs. With the improvement of the manufacturing process will follow a revolutionary development of manufacturing technology (The International Journal of Advanced Manufacturing Technology, 1997).

In conclusion, it has been found that changes in the production process have a high impact on the organization. The results revealed that achieving a goal is in the manufacturing level of an organization, and the implementation of the change may be conditioned by factors such as lack of materials at the time of production, exceeding a date, customer involvement, financial resources. Finally, it was shown that the

characteristics of defining the environment in which to carry out the activities of managing and implementing a change have an impact on the level of flexibility of the activities involved.

“Improvement” is a skill acquired during the conduct of an enterprise’s internal activities (Swamidass, 2001).

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